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(54) Generator output regulator

(57) Rectified direct current at constant voltage is obtained from an alternator 1, driven over a wide range of speeds, by moving a permanent magnet rotor 5 axially in relation to the stator 3 to decouple the magnet flux from the stator windings 2 when the speed rises. The rotor 5 is moved by means such as an hydraulic piston 16 controlled by a bi-directional valve 21 according to an error signal proportional to the difference between the actual generator voltage and the required constant voltage. The rotor is moved in a direction to reduce this error signal.

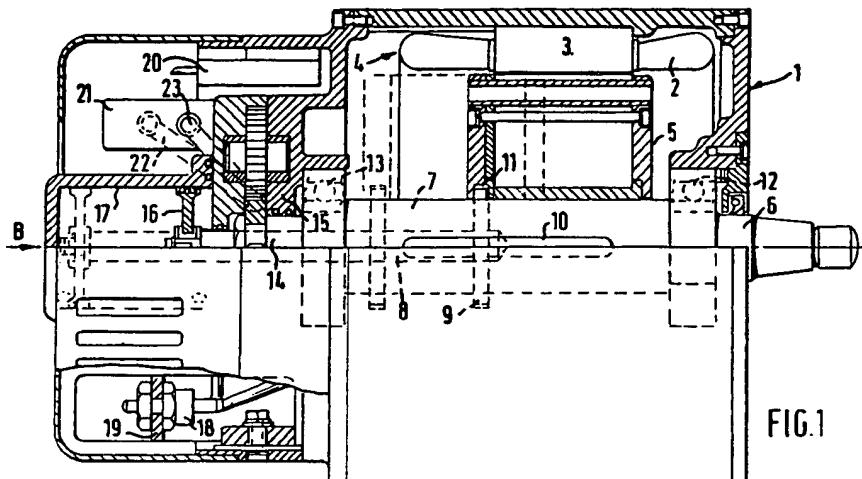
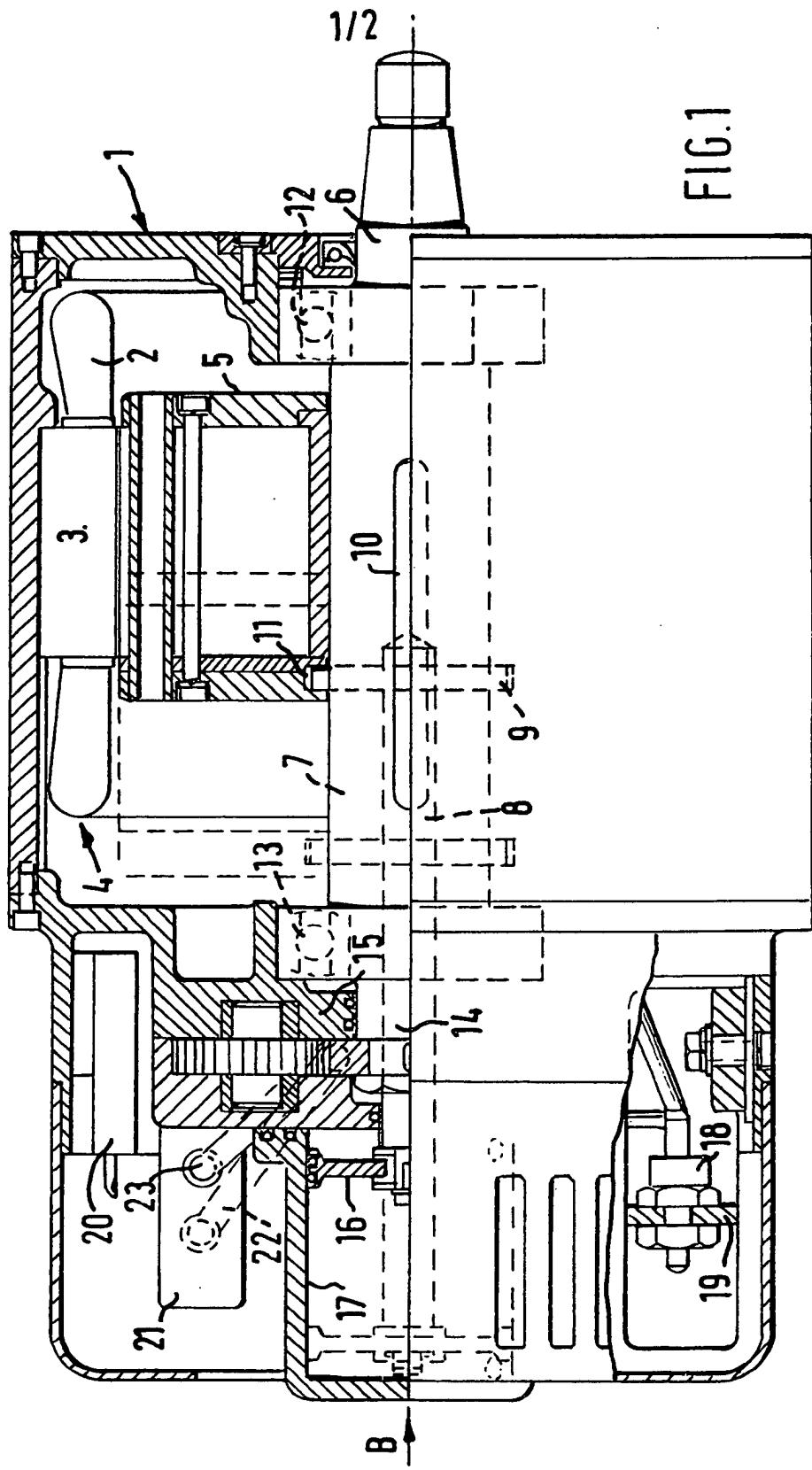


FIG.1

The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

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FIG.1



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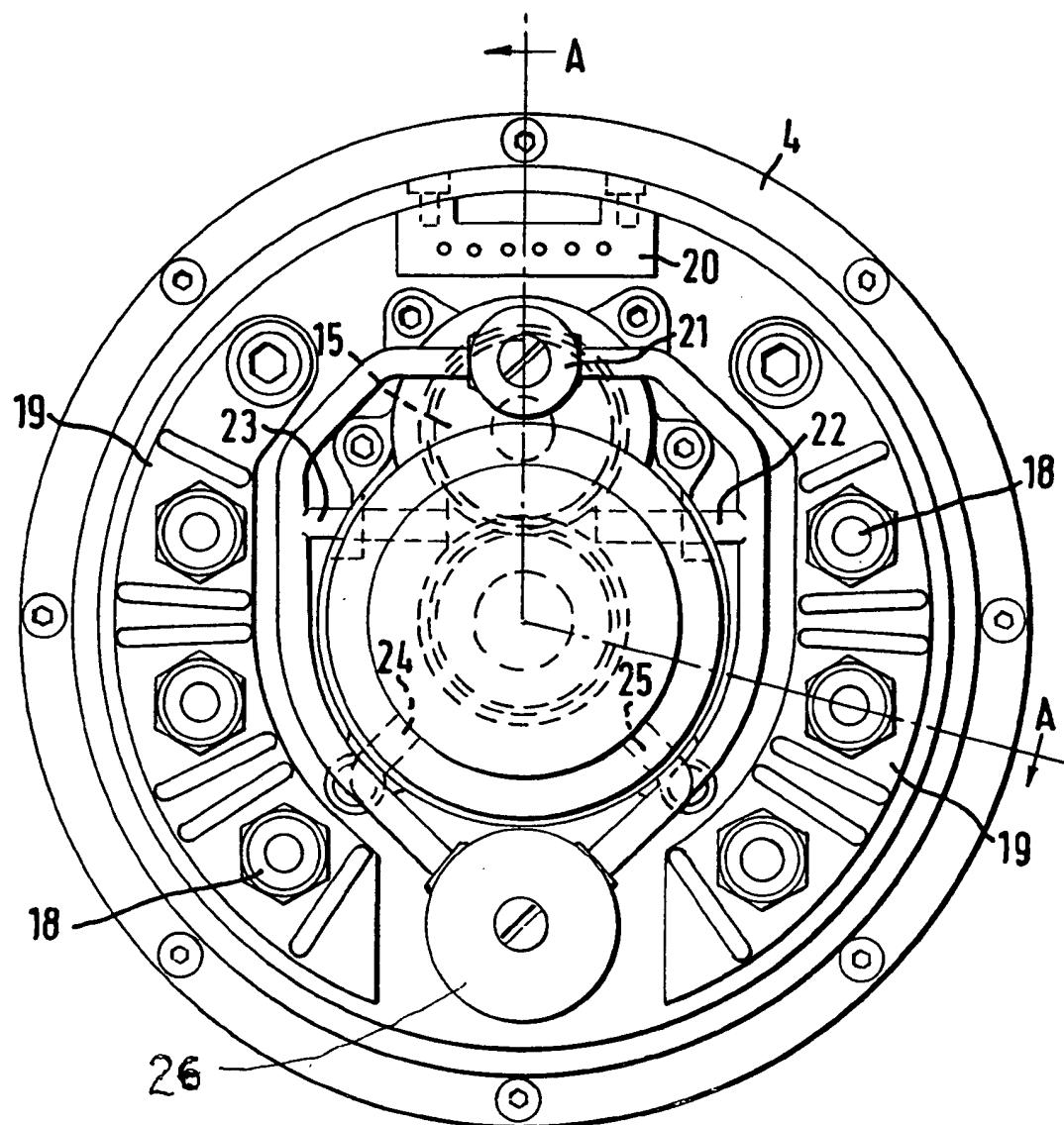


FIG. 2

SPECIFICATION

Electrical generator producing constant direct current over a wide speed range

5 This invention is concerned with electrical alternators required to produce a constant voltage or current when driven over a wide range of speeds. A particular application is to
 10 alternators used on heavy duty vehicles which are driven from the vehicle engine at speeds varying over a wide range and which are required to supply direct current at a substantially constant voltage. For convenience, the
 15 invention will be described in relation to this use, though it will be understood that it is not restricted to such use.

Alternators on heavy duty vehicles are required to need little or no maintenance attention during some years of operation when working in hot, dirty and vibrating surroundings. They should be light in weight, of minimum volume and yet have a sufficiently low temperature rise that the life of insulating
 25 materials, electronic components and lubricants is not unreasonably diminished. More particularly, they are driven from an engine of which the speed may vary over a wide range of four or five or more to one which results in
 30 unacceptable losses and consequent temperature rise in the alternators when running at other than the designed optimum speed.

From one aspect, the invention provides an alternator comprising a wound stator, a high
 35 coercivity permanent magnet rotor coaxial with the stator and means to move the rotor axially into and out of the stator core in accordance with the speed of the rotor to decouple the permanent flux from the generating coils of the stator to maintain constant the output (voltage or current) of the stator winding.

From another aspect, the invention provides an alternator comprising a wound stator, a
 45 rotor excited by permanent magnets of high coercivity and rotatable over a wide range of speeds within the stator, means to compare the output of the stator winding with a predetermined reference output to derive an error signal proportional to the difference between the actual output and the reference output and means operated in accordance with the error signal to move the rotor relatively to the stator core in a direction to reduce said difference.

From another aspect, the invention provides an electrical generator producing direct current at constant voltage or current from a power source operating over a wide range of
 60 speeds comprising an alternator having a wound stator and a permanent magnet rotor driven by the power source the magnets of said rotor being of high coercivity, and said rotor being axially movable in relation to said stator, rectifying means connected to the out-

put of said stator winding, a regulating system to compare the actual voltage from said rectifying means with a reference voltage to produce an error signal proportional to the difference between said actual voltage or current, and the desired constant voltage or current and means controlled in accordance with said error signal to move said rotor axially into or out of the stator core in a
 75 direction such as to reduce said error.

The permanent magnets of the rotor operate on a straight line portion of their B-H curve so that the rotor may move into and out of the stator core without appreciable demagnetisation of the magnets.

The reference voltage may be a zener reference voltage and the error signal may be amplified to produce a signal sufficient to control the movement of the rotor.
 85 The means for axially moving the rotor may be of any suitable form, mechanical, electrical or hydraulic. In one preferred form, the amplified error signal is fed to the operating coil of an hydraulic bi-directional valve which controls movement of an hydraulic piston moving the rotor. In another form, the rotor is moved by a linear step-by-step electric motor controlled by the amplified error signal. In another form a servo motor, gearing and a
 95 lead screw is used.

Other parts of the invention are embodied in the preferred form which will now be described in some detail, by way of example, with reference to the accompanying drawings,
 100 in which:

Figure 1 is a side view partly in section on the line A-A of Fig. 2 of an electrical generator according to the invention; and

Figure 2 is an end view, in the direction of
 105 the arrow B in Fig. 1.

The electrical generator shown in Figs. 1 and 2 comprises an alternator 1 with for example, twelve poles. The stator 4 has a winding 2 wound in the conventional way on
 110 a laminated, slotted stator core 3. The rotor 5 has twelve poles produced by twelve ferrite permanent magnets mounted between twelve laminated soft iron poles from which the magnetic flux passes radially into the stator. Ferrite permanent magnets have high coercivity as is necessary to avoid demagnetisation during operation of the machine. The winding on the stator is arranged to produce three phase alternating current at a frequency which is six
 115 times the revolutions per second of the rotor rotational speed.

The rotor 5 is mounted on a drive shaft 6 comprising an outer tubular portion 7 surrounding an inner shaft 8 which is axially
 125 movable therein. Radial pins 9 extend from the shaft 8 through longitudinal slots 10 in the outer tube 7 and engage recesses 11 in the rotor 5. The rotor 5 is thereby rotated by the drive shaft whilst being axially movable
 130 therealong from a position shown in full lines,

**ANHANG ZUM EUROPÄISCHEN RECHERCHENBERICHT
ÜBER DIE EUROPÄISCHE PATENTANMELDUNG NR.**

EP 02 00 4167

In diesem Anhang sind die Mitglieder der Patentfamilien der im obengenannten europäischen Recherchenbericht angeführten Patentdokumente angegeben.

Die Angaben über die Familienmitglieder entsprechen dem Stand der Datei des Europäischen Patentamts am
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21-06-2002

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